

Exhibit C

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# **Proposal For Low-Cost OC192 Interface Projects**

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Exhibit C

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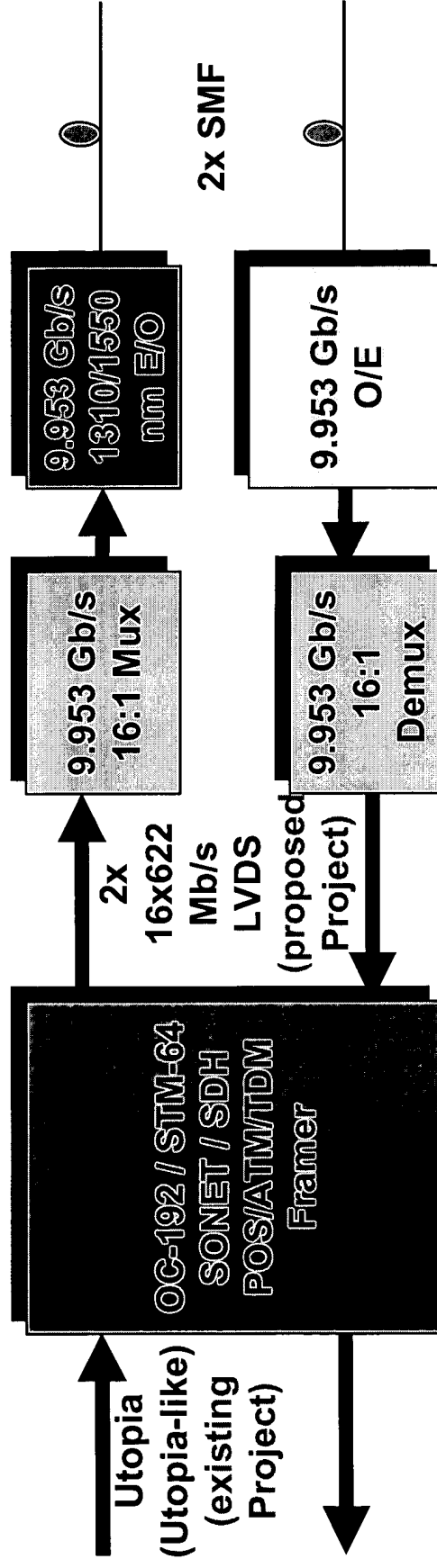
# Abstract

- At the January 1999 meeting, the TC authorized a Project in the PLL WG to *Develop a lower-cost 10 Gb/s interface for intra-office data applications.* This contribution proposes that the OIF TC refine this Project definition to develop standards for low-cost OC192 telecom interfaces based on existing and forthcoming datacom technology.

# Background

- **OC-192 technology is still very expensive**
  - Next-generation semiconductor technology will enable less expensive 10 Gb/s communications
  - Costs will drop and follow Moore's law cost curves
    - Just like OC-48, OC-12, OC-3, Gigabit/Fast Ethernet, etc.
- **Gigabit Ethernet is currently in *sweet spot* of price/performance curve**
  - < \$100/Gb/s (GE) vs. > \$1,000/Gb/s (OC-192)
- **Parallel optics technology builds on Gigabit Ethernet (GE) at GE prices (for HIPPI 6400)**
  - Opportunity to leverage for Optical Internetworking

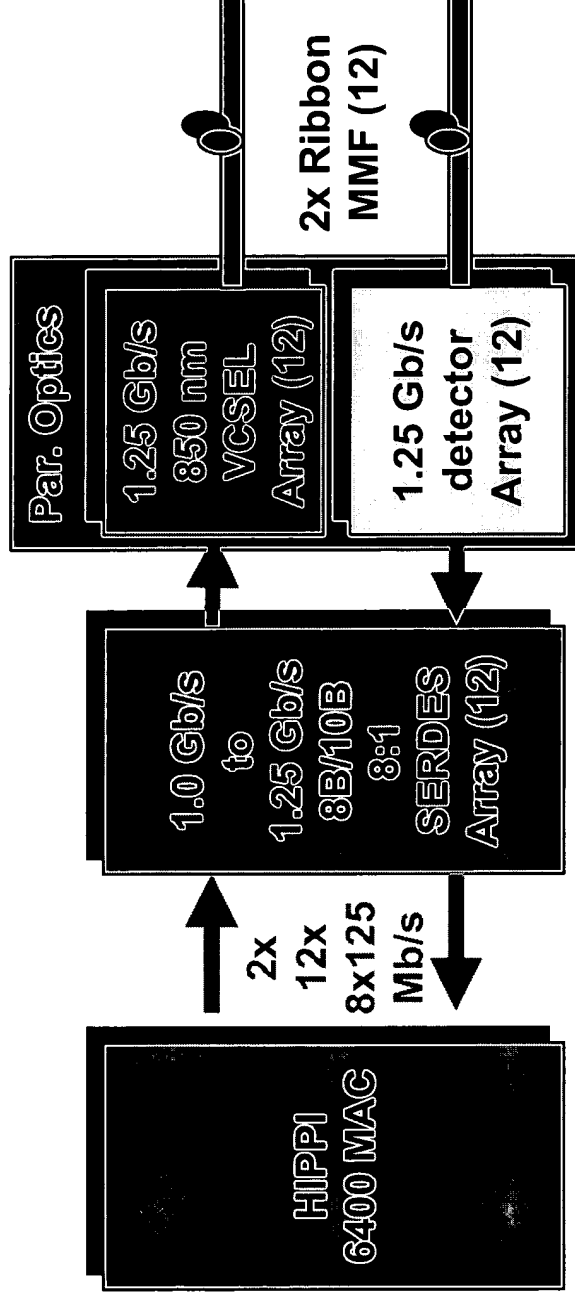
# OC-192 Optics Technology Architecture



## • Very expensive today (> \$10,000 both ends)

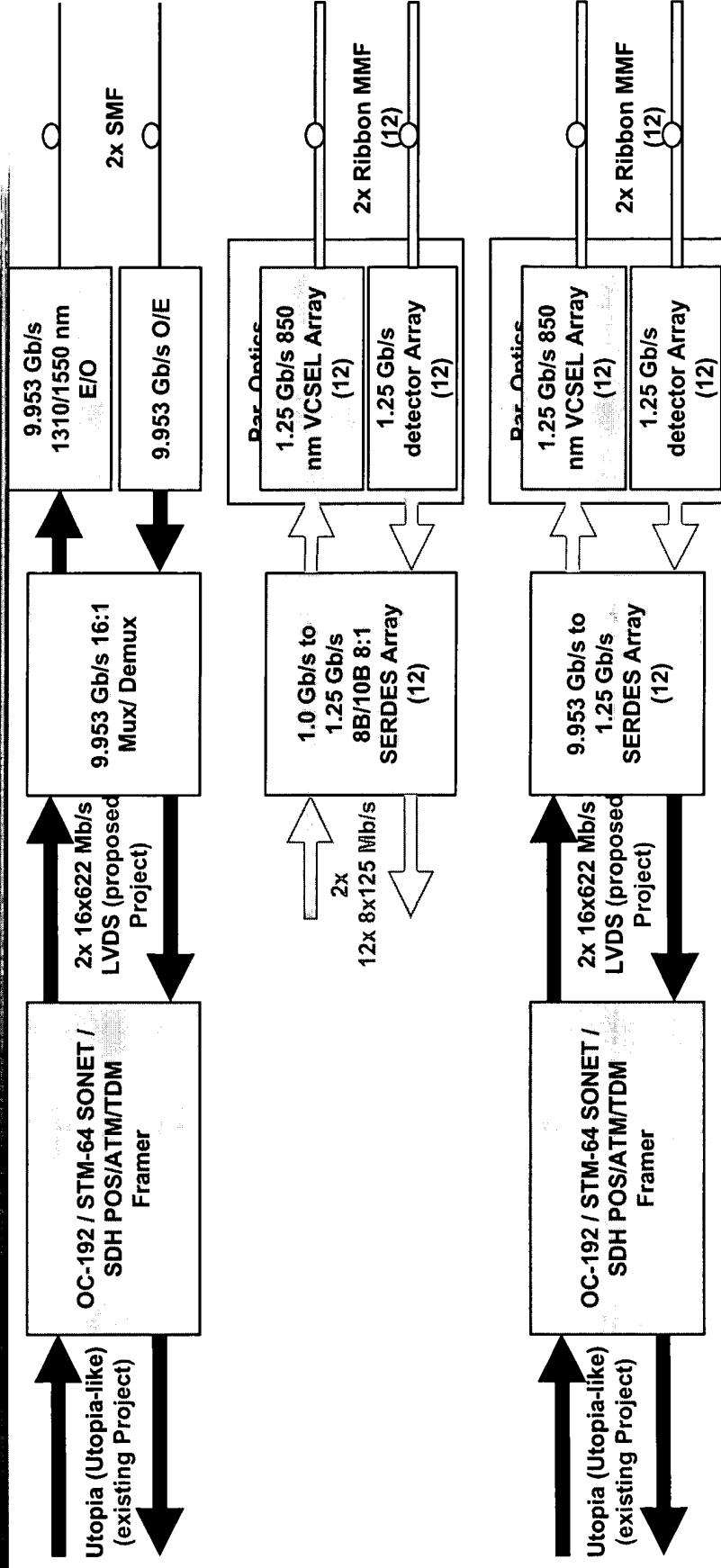
- Framing is NOT the expensive part
- Mux, demux, E/O, and O/E are all very expensive today
- Yes, costs will drop eventually...

# 12 x 1.25 Gb/s Parallel Optics Technology Available Now



- 12 Gb/s data throughput (15 Gb/s after 8B/10B)
- Very inexpensive (< \$1,000 both ends)
- Available today!

# All We Need Is an OC-192 to 12x1.25 Gb/s Converter



- Merge two solutions for best of all worlds!
- Opportunity to converge Datacom and Telecom



# **IEEE standardization process for 10 Gb/s Ethernet has begun**

- IEEE 802.3 High Speed Study Group (HSSG)
- Multiple proposals that may meet different cost points for different applications
- IEEE will probably develop multiple standards like it did for Gigabit Ethernet (SX, LX, etc.)
- Another opportunity to converge Datacom and Telecom

# **Agreed 10 Gb/s Ethernet Application Distances**

- At least 100 m over installed MMF
  - At least 300 m over MMF
  - At least 2 km over SMF
  - At least 10 km over SMF
  - At least 40 km over SMF
- 
- Which of these are useful for Optical Internet networks?

# Some 10 Gb/s Ethernet Proposals

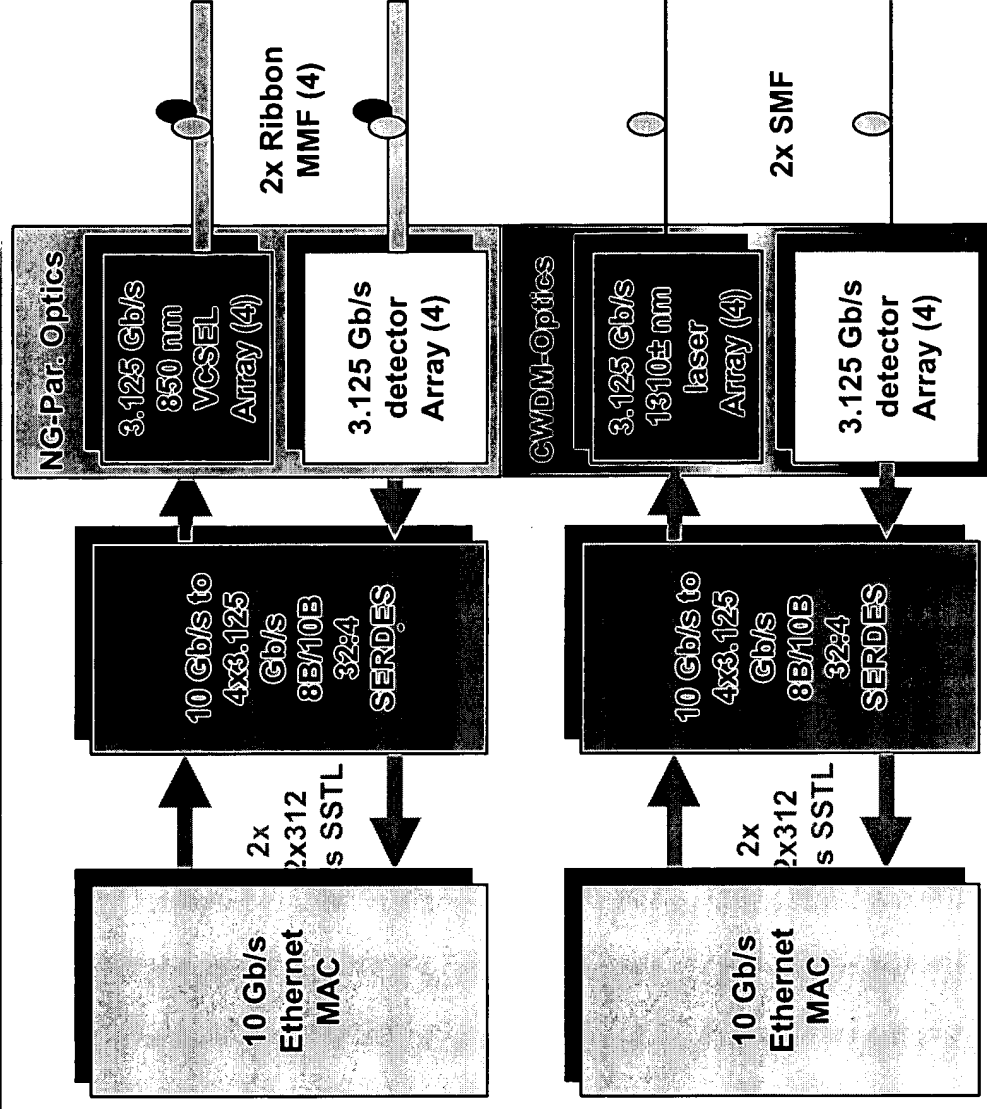
- **Short wavelength (850 nm) / distance (SX)**
  - 8 x 1.25 Gb/s (1.0 Gb/s before 8B10B) CWDM
    - not 10 Gb/s throughput?
  - 4 x 3.125 Gb/s (2.5 Gb/s before 8B10B) ribbon fiber
  - Multilevel Analog Signaling (MAS)
    - Multiple bits/ baud
- **Longer wavelength (1310 nm) / distance (LX)**
  - 4 x 3.125 Gb/s (after 8B10B) CWDM
  - Serial 12.5 Gb/s (after 8B10B)
  - Serial 9.953 Gb/s (with scrambling)
    - Subset of OC192

# **3.125 Gb/s 8B10B Technology Gaining Momentum**

- Likely to be used for one or more 10 Gb/s Ethernet proposals
- 3.125 Gb/s 8B10B technologies will be available in 2000 independent of Ethernet
  - 8B/10B SERDES (2.5 Gb/s data throughput)
  - Individual, parallel, and CWDM 850 nm optics

# 4 x 3.125 Gb/s 10 GE Technology

- 10 Gb/s data throughput (12.5 Gb/s after 8B/10B)
- Will be very inexpensive when available



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# **Opportunity for Telecom to Leverage Datacom Technology**

- **Very close data rate match from 10 Gb/s Ethernet to OC192 (before 8B/10B)**
- **Can map OC192 (9.953 Gb/s) to 10 Gb/s (before 8B/10B)**
  - Can utilize 8B/10B control characters to pad or stuff channel to adjust timing
- **Or can map OC192 (9.953 Gb/s) to 4x3.110 Gb/s (after 8B/10B)**
  - Can lock serial link timing to OC192 / 4 timing

# Standardization Plan

- Develop standard for striping an OC-192/STM64 across 12x1.25Gb/s or 4x3.125 Gb/s links
- Leverage HIPPI 6400 (ANSI) 12x1.25 Gb/s standards work
  - Already available
- Leverage IEEE 802.3 4x3.125 Gb/s standards work as it becomes available
- Standardization takes time
  - Current generation 12x1.25 Gb/s components can be used if IEEE takes a long time
  - Next-generation 4x3.125 Gb/s components can be used if OIF takes longer

# Motion 1

- OIF TC to authorize a Project in the PLL WG to develop a low-cost OC192/STM64 interface based on 12x1.25 Gb/s parallel optics with 8B10B technology. This interface to be compatible with the PMD layer from the expected ANSI HIPPI6400 standard. This project refines the already-authorized Project to *Develop a lower-cost 10 Gb/s interface for intra-office data applications.*



## Motion 2

- OIF TC to authorize a Project in the PLL WG to develop low-cost very short reach OC192/STM64 interfaces based on 4x2.5/3.125 Gb/s parallel optics technology. This interface to leverage the low cost optical layer expected from IEEE 10 Gb/s Ethernet Standards.

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